REMARKS

This is in response to the Office Action dated September 11, 2008. Claims 4-34 are pending. Claims 4-34 stand rejected in the outstanding Office Action. Claims 4 and 5 have been amended.

The rejection of claim 4 under 35 U.S.C. § 103(a), as allegedly being unpatentable over Kawasaki et al. (US 2003/0047785) in view of Goodman (US 4,204,217) and further in view of Yan et al. (US 2003/0218222), is respectfully traversed.

Amended claim 4 now recites "said nitrogen and hydrogen are added to the active layer *so that to control a threshold voltage of the semiconductor device to be on the order of 0 V*". Support for the amendment can be found, for example, in p. 62, line 17 to p. 63, line 6 of the instant specification. Kawasaki/Goodman/Yan fails to teach or suggest this feature.

The Examiner stated that Kawasaki teaches a semiconductor device made of a semiconductor containing ZnO or $Mg_xZn_{1-x}O$ and a blocking member, but lacking a teaching of nitrogen and hydrogen being added to the active layer, which contains a polycrystalline or amorphous ZnO or $Mg_xZn_{1-x}O$. The Examiner then turned to Goodman and Yan for the missing limitations.

Goodman generally describes a transistor 10 used in conjunction with liquid crystal 18 (see, for example, Fig. 1), wherein it is taught that the element 16, which corresponds to the active layer 30 of a MOS field effect transistor 22 (Fig. 2) comprises amorphous or polycrystalline ZnO (lines 7-9, col. 2).

Yan discloses a method for fabricating high-quality p-type transparent conducting films. More specifically, Yan teaches that "[h]igh quality p-type ZnO films can be achieved using either NO or NO_2 gas as a dopant" ([0036]).

The Examiner then concluded that it would have been obvious to one of ordinary skill in the art to dope the active layer disclosed by Kawasaki in the form of polycrystalline or amorphous ZnO and use either NO or NO_2 gas as dopant for the ZnO film, thus inherently adding nitrogen to the active layer. Regarding the limitation of adding hydrogen to the active layer, the Examiner asserted that the active layer disclosed by Kawasaki/Goodman/Yan may be unintentionally doped (emphasis added) with hydrogen because "hydrogen is a common impurity that can unintentionally dope a semiconductor layer in a vacuum chamber or an air ambient via incorporation of hydrogen molecules, organic molecules or water molecules into the semiconductor layer" (emphasis added).

Finally, regarding the limitation that the active layer is formed under an atmosphere containing (i) one or more of nitrogen monoxide and nitrogen dioxide and (ii) one or more of water vapor and hydrogen peroxide missing from Kawasaki/Goodman/Yan, the Examiner asserted that the limitation represents a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art.

With the above amendment, it is made clear that the claimed semiconductor device requires intentional doping with hydrogen in the active layer to ensure that the threshold voltage is on the order of 0 V.

In the claimed device, the active layer is doped with nitrogen and hydrogen so as to reduce the number of free electrons. Using these elements also causes the Fermi level to decrease to the center of the band gap, thus allowing a decrease in the gate voltage required for removal of the too many electrons, with the result that the threshold voltage becomes on the order of 0 V (p. 63, lines 4-21 in the instant specification).

The claimed device also requires doping with hydrogen to allow "restraint of a TFT property change (threshold voltage shift ΔVth) occurring over time in response to application of a positive voltage, as shown in Fig. 18" (p. 63, lines 22-25 in the instant application). Therefore, the doping of hydrogen in the claimed device must be intentional to ensure that the threshold voltage shift is restrained. It would not be possible to guarantee this with unintentional doping with hydrogen.

It is submitted that this restraint of the threshold voltage is not disclosed in any of the cited references. Goodman discloses a "threshold" for turning the transistor "on" is above zero (i.e., positive voltage - if the voltage drop is zero or less, the display portion is not turned "on"), see col. 4, lines 56-67 in Goodman. However, Goodman does not consider any form of control for this threshold voltage.

Comparison of Figs. 15 and Fig. 17 of the instant specification shows that controllably doping the active layer with nitrogen and hydrogen causes the threshold voltage to be on order of 0 V (see Fig. 17) compared to the threshold voltage of an active layer, provided with a protective layer but without added nitrogen and hydrogen, whose threshold voltage is on the order of -40 V (see Fig. 15), see also p. 62, lines 17-24 of the instant specification. Therefore, unintentional doping of the active layer with hydrogen would not produce an active layer with the claimed property of having a threshold voltage on the order of 0 V. Kawasaki/Goodman/Yan does not teach doping the active layer with hydrogen.

For the above reasons, claim 4 is allowable.

Regarding amended claim 5, said claim now recites "forming the active layer under an atmosphere containing…and (ii) hydrogen peroxide". . The Examiner asserted that "it would have been obvious, if not inherent, to one of ordinary skill in the art that the active layer

disclosed by Kawasaki/Goodman/Yan may be formed under an atmosphere containing water vapor, because water vapor is a common molecule as well as hydrogen-containing molecules in a vacuum chamber or an air ambient". However, the Examiner has provided no reference for teaching exposing the film to hydrogen peroxide without water vapor.

For at least the above reason, claim 5 is allowable.

It is respectfully requested that the rejection of claims 5-34, each one dependent from claim 4, also be withdrawn.

In view of the foregoing and other considerations, all claims are deemed in condition for allowance. A formal indication of allowability is earnestly solicited.

The Commissioner is authorized to charge the undersigned's deposit account #14-1140 in whatever amount is necessary for entry of these papers and the continued pendency of the captioned application.

Should the Examiner feel that an interview with the undersigned would facilitate allowance of this application, the Examiner is encouraged to contact the undersigned.

Respectfully submitted,

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